LONG TERM STORAGE OF GRAINS WITH GRAIN CHILLING TECHNOLOGY

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GRAIN CHILLING – THE MAIN PURPOSE

MAINTAINING QUALITY OF GRAINS DURING POST HARVEST STORAGE

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• CONCEPT OF GRAIN CHILLING?
• HOW DOES A GRAIN CHILLER WORK?
• NECESSITY OF USING A GRAIN CHILLER & ITS BENEFITS
• OPERATIONAL FEASIBILITY
• SUCCESSFUL IMPLEMENTATION OF CHILLING TECHNOLOGY
• QUESTIONS & DISCUSSIONS
CONCEPT OF GRAIN CHILLING

- Designed for providing a solution when inadequate ambient conditions don’t allow long term storage of grains
- A technology using a refrigeration system to provide conditioned air into a silo / warehouse
- Keeping grains safe during storage times by maintaining precise temperatures & Relative Humidity levels
- Conceptualized since storage under 15º C can eliminate various factors leading to damage of grains

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FIRST INDIGINEOUS GRAIN CHILLER
ATTACHING TO SILO

- Can be easily integrated to an existing / new silo through Aeration Fan Opening
- Using the Aeration Channels inside silo, cold dehumidified air sent through the grain
- Hot air after heat exchange is sent out through Air Vents on silo roof
COMMON ISSUES FACED BY MILLERS

- Weevil Infestation
- Mildew / Fungal Growth
- Dry matter loss due to grain respiration
- Loss of Protein Content
- Germination Loss
- Broken Grains
- Shrinkage due to Aeration
- Discolouration of grains
Effect of the Hygroscopic Nature of Food Grains

They may retain, absorb or release water vapor, and excessive amounts of inherent moisture may lead to significant self-heating and "moisture migration" within the silo/warehouse/cargo resulting in baking, mildew or rot.
WHY GRAIN CHILLING?

IDEAL SOLUTION FOR STORAGE

AVOID BAKING/WETSPOT/DISCOLOR/FOUL SMELL/DECAY OR POWDER/WEIGHT LOSS

Grain lives and due to the respiration it releases heat, water and carbondioxide
WHY GRAIN CHILLING?

Various Risks of Quality Deterioration in the Ecosystem of Bulk Grains

- Moulds Growth
- Condensation
- Water Vapor
- Respiration (generates heat and moisture)
- Germination
- Damage by insects
- Wetting from air
- Damage by rodents & birds

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Losses of Lusture

Kernels which are materially dis-colored by excessive respiration. The discoloration originates from the germ area and continues through the sides and back of the kernel.
Shrinkage

- Shrinkage is physically noticeable and attributes to financial loss in grain storage (physical weight loss due to moisture loss).
- Shrinkage causes irreversible changes to starch molecules limiting digestibility and nutrient availability.
Insect Infestation

Insects Multiply at Optimal Conditions

- Khapra Beetle
- Lesser Grain Borer
- Rice Weevil
- Red Flour Bettle
Insect Infestation

Below 13 C no insect activity & no damage
Silo Corrosion

- Sweating and caking at side wall – visible corrosion to silo wall.
Fungus Risk

Different types of fungi thrive at different moisture contents and temperatures in stored grain.

- **A** – Aspergillus species which may damage germination and cause slow heating.
- **B** – Penicillium species, including those that produce mycotoxins.
- **C** – Advanced decay/field fungi, e.g., Fusarium species and heating organisms, e.g., Absidia species which may be pathogenic causing, for instance, farmers’ lung.
- **D** – Thermophilic fungi, which thrive at very high temperatures, such as those that occur in compost bins.
Inadequate Tropical Climate for Storage

- Chilling Technology proves to be an effective tool for post harvest storage in Hot & Humid Sub Continent Conditions
- Grain Chilling can supply uniform Temperature & Relative Humidity to target grain equilibrium levels
CHILLED VS NORMAL AERATION

AERATION IS MUST BUT ONLY POSSIBLE WITH THE RIGHT TEMPERATURE & RH%

Risk when ventilating with ambient Aeration

If humid air is blown into dry grain, moisture content will increase. High amounts of moisture build-up when the air temperature is higher than the grain temperature.

No Risk with Chilled Aeration / Grain Chilling

When Chilled Air at a set specified Temperature & RH% is blown in to grain, there is no risk of Moisture Addition. Temperature is reduced & grain remains fresh.

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Cold Grain Remains Cold

Grains are relatively warm post-harvest – ideal for insect breeding and other activity. Grain, being a good insulator, loses heat very slowly which signifies that once the grain is cold it remains cold for a longer period of time.

Only Point to Point Contact & low Convection of Air
Conclusion: In the Control bin there was a significant decrease in quality after 38 days storage period. It is observed that protein content decreased from 11.87% to 11.27%. Mixing time also decreased from 3.53 to 3 minutes, as well as loaf volume decreased from 818.34 cc to 767 cc.

Ref: According to Study Published by IOWA State University, USA
## Operational Cost Calculation

### SAMPLE OPEX CALCULATION

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td><strong>Model</strong></td>
<td>GT-450</td>
</tr>
<tr>
<td><strong>Nominal Cooling Capacity</strong></td>
<td>Approx. 400 Tons per day</td>
</tr>
<tr>
<td><strong>Silo Capacity</strong></td>
<td>7500 MT</td>
</tr>
<tr>
<td><strong>No. of Days Required for chilling grain inside silo including re-chilling</strong></td>
<td>24 / 180</td>
</tr>
<tr>
<td><strong>Total Running Hours per day</strong></td>
<td>24</td>
</tr>
<tr>
<td><strong>Total Running Hours</strong></td>
<td>576 Hours</td>
</tr>
<tr>
<td><strong>Avg Power Consumption</strong></td>
<td>78 Kw</td>
</tr>
<tr>
<td><strong>Total Units Consumed</strong></td>
<td>44,928</td>
</tr>
<tr>
<td><strong>Est. Unit Cost</strong></td>
<td>8 Rs./Kwhr</td>
</tr>
<tr>
<td><strong>Total Running Cost (Approx.)</strong></td>
<td>Rs. 3,60,000/-</td>
</tr>
<tr>
<td><strong>Total Chilling Cost per Ton</strong></td>
<td>Rs. 48 / Ton</td>
</tr>
<tr>
<td><strong>Total Price of Wheat in Silo</strong></td>
<td>Rs. 12,75,00,000/-</td>
</tr>
<tr>
<td><strong>1% Loss of Grain in Silo</strong></td>
<td>Rs. 12,75,000/-</td>
</tr>
<tr>
<td><strong>2% Loss of Grain in Silo</strong></td>
<td>Rs. 25,50,000/-</td>
</tr>
<tr>
<td><strong>3% Loss of Grain in Silo</strong></td>
<td>Rs. 38,25,000/-</td>
</tr>
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- Wheat Storage for 6 months during Summer & Monsoon Season
- Wheat Selling Price Estimated – Rs. 17,000 / Ton
Advantages of Chiller

- Weather Independent
- No risk of grain spoilage for the total duration of storage
- No risk of insects
- Maintaining Alcohol Acidity in Wheat
- No risk of Fungal Growth
- No foul smell; harvest freshness is maintained
- Maintaining high germination rates
- No respiration loss
- No grain powdering
- No discoloration
- High Milling performance
GT-GRAIN CHILLER

Key Applications

- Paddy
- Milled Rice
- Wheat
- Malting Barley
- Maize
- Poultry Feed
- Oil Seeds
- Peanuts
- Soya Beans
- Dal (Lentil)

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SUCCESSFUL INSTALLATIONS

NCML, Bihar – Storage of Maize
SUCCESSFUL INSTALLATIONS

Sneha Farms, Hyderabad – Storage of Maize
Installations

KRBL Ltd. (India Gate Basmati) – Storage of Paddy
Installations

ITC Ltd. – Storage of Wheat
Installations

Storage of Maize for Poultry Feed
Installations

Storage of Maize
Installations

Storage of Maize
THANK YOU !!